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Hospital Based Study: Prevalence and Predictors of type 2 diabetes mellitus in Rural Population of Haryana

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ABSTRACT

Objective: There is no information available on the prevalence of type 2 diabetes from rural population of Haryana. Therefore, a study was conducted to find out the prevalence rate and risk factors associated with type 2 diabetes. **Methods:** A retrospective study and prospective study was done in OPD of M M Institute of Medical Science and Research. **Results:** Among the hospital based patients the overall prevalence of type 2 diabetes was 4.70%. The prevalence was more number in females than males, respectively. Waist circumference, waist hip ratio, systolic blood pressure and fasting blood glucose was statistically significant among type 2 diabetes patients than normal controls. Multivariate logistic regression analyses revealed that the risk of type 2 diabetes mellitus was significantly associated with body mass index and fasting blood glucose. **Conclusions:** This study showed that the prevalence of type 2 diabetes mellitus in rural population was low compared to previous studies on urban population of Haryana. Prevalence is influenced by body mass index and fasting blood glucose.

1. Introduction

Non communicable disease associated with changes in lifestyle and diet has become a major public health problem in developing countries. Diabetes mellitus is the third most common health disorder worldwide and fourth leading cause of death. The incidence and prevalence of type2 diabetes mellitus are rapidly increasing worldwide in both developing and developed nations. According to recent analysis the number of adults with diabetes from 2010 to 2030 would increase 20% in developed countries and 69% in developing countries [1]. Such a dramatic rise in the prevalence of diabetes will have great impact on the socioeconomic status of nations around the world. Several reports studied on Asian Indians living in different parts of the world showed that these populations had a higher prevalence of diabetes than other ethnic groups living in the same countries [2]. Most of the them have type 2 diabetes mellitus. A strong genetic basis, environmental factors and lifestyle changes have been implicated in the etiology of type 2 diabetes mellitus. It is becoming increasingly apparent that epigenetics may bridge both the 'thrifty genotype' and thrifty phenotype' hypothesis and provide a link between genes and the environment concerning disease predisposition to metabolic syndrome and related diseases [3]. The biggest increase in diabetes mellitus cases is expected in China and India. India currently, have around 40 million cases of diabetes mellitus and these numbers are projected to increase to 87 million by the year 2030 [4]. Anticipating and epidemic like, increase in the number of diabetic patients India have been christened as the 'diabetic capital of the world [5]. The prevalence of type 2 diabetes mellitus has risen from 1.2% to 11% over last three decades [6]. Indians is limited, considering the socio-economic and rural-urban disparity and the great

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cultural, geographical and racial diversity of our country. The prevalence has been reported by various methods, including surveys, national or central registries, school records and hospitals records, in various age groups [7]. Very high levels of diabetes have been reported in urban areas of India but few data are available for rural regions where >70% of the population lives. In fact now a day's prevalence of diabetes is increasing more in rural areas than urban areas [4]. People knowledge about diabetes is not commensurate with the magnitude of the problem in India.

Various Studies conducted in India in the last decade have highlighted the prevalence of type 2 diabetes was increasing rapidly in the urban population [8, 9]. Three diabetic surveys conducted on Chennai (South India) in years 1989, 1995 and 2000 showed a rising trend of diabetes which was statistically significant. Another study conducted in 1991 New Delhi (North India) in urban region showed that prevalence of diabetes has increased 2.9 times in 2 decades to 6.7% from 2.3% in 1972 [10,11]. These differences could be because of north Indians are migrant Asian populations while the south Indians are the host population. Despite the extensive diabetes research and being established diabeteologist and diabetes centers the situation in rural part of India, where such facilities are not available is likely to be much worse. Prevalence of type 2 diabetes mellitus in rural population is an important public issue. There is relatively less number of studies in rural areas. However, India has 80% of its population in rural areas; hence it is important to measure the prevalence in rural areas also [12]. Diverse ethnic groups with distinct cultures live in Haryana which is a Northern State of India. Till date there is only two prevalence study reported on urban population of Haryana (Rohtak and Karnal) which focused on prevalence rate of diabetes mellitus. No information is available on prevalence of type 2 diabetes mellitus in rural population of Haryana. So our aim is to find out the prevalence of type 2 diabetes mellitus patients among different diseases and to identify various risk factors associated with it.

2. Methodology

2.1 Place of survey

Mullana, a small block of rural area (Figure 1) under district Ambala in the state of Haryana with tropical climate had been the place of survey. The population is stable and usually consumes high cholesterol, alcohol, salt and saturated fat [13] which is a main cooking medium. The hospital based study was carried out in M. M. Institute of Medical Sciences and Research, Mullana which is the only established Hospital in the rural region nearby Ambala where the patients come for treatment within the radius of 30 km. A total of 18021 patients cases were studied under retrospective study. The patients with were only higher than normal glucose level considered as diabetes mellitus. To find out the sample size, the formula used n= pq(1.96)2/(d)2, where p = prevalence of hypertension in a rural population of Haryana was 10% [7] with 95% confidence level and 90% power. The study was approved by Human Ethical Committee of M M Institute of Medical Science and Research, Mullana (IEC/30) before the experiment start.

Figure 1 Map of studied rural area of Haryana

2.2 Design

a) To achieve the objectives, a hospital based retrospective and prospective study was conducted at M. M. Institute of Medical Science and Research, Mullana, Haryana. The retrospective study was conducted at patient information center to find out the prevalence rate of type 2 diabetes mellitus among other diseases during the period 2007 to 2010. A total of 18021 (9235 males and 8786 females) patients who visited the OPD, of which 861 were type 2 diabetes mellitus. The patient population were further divided into two major sub-groups on the basis of their underlying etiology;

i) Individuals with only diabetes mellitus (n =861).

ii) Other diseases (n = 17160), individuals with other acute and chronic diseases.

For prospective study, the demographic details with disease history of type 2 diabetes mellitus patients were investigated in Outdoor Patient Department (OPD) of the hospital during October 2010 to March 2011 to identify various risk factors includes anthropometric variables, biochemical parameters and other information like smoking, alcohol consumption

involved in it. The control subjects were recruited from employees of M. M. Institute of Medical Science and Research, Mullana, Haryana who is residing in this area.

For Pharmacogenomics study, each 45 controls and type 2 diabetes mellitus patients were selected from prospective study (October 2010 to March 2011) which was untreated and maintained on anti-diabetic therapy (data not included).

2.3 Inclusion criteria

For Patients

*Physicians diagnosed patients with type 2 DM {FBG $\geqslant$126mg/dl} who were untreated with anti-diabetic drugs.

*The type 2 DM patients who were between 30 and 80 years of age.

*Patient should be residing in the area of investigating for last at three generations.

For Control:

*Individuals who were having fasting blood glucose {FBG γ 126mg/dl}were considered as non diabetic mellitus

*Individuals who were between 30 and 80 years of age.

*Individuals who were not received any anti-diabetic therapy.

Cases with type 2 diabetes mellitus were age and sex matched to normal controls (Table 1). The normal control population comprised of 27(45.76%) males and 32 (54.23%) females. The age of males ranged between 40 and 76 years with a mean age of 55.59 (SD 9.42) years. In females the age ranged from 40 to 75 years with a mean age of 55.75(SD8.57) years. The cases with diabetes mellitus comprised of 29 (48.34%) males and 31(51.66%) females. The age of males ranged from 30 to 75 with a mean age of 56.58 (SD 11.01) years and female age ranged between 30 and 68 with a mean age of 50.83 (SD 8.90) years.

2.4 Survey instrument

For better classification of diabetic patients, the information was collected regarding biochemical parameters (fasting glucose, HDL, triglycerides, LDL and total cholesterol), sociodemographic profile (age, sex & family history of diabetic mellitus), anthropometry (BMI, waist hip ratio), smoking, alcohol use and salt intake as well as details of drug treatment prescribed (name, dosage form, frequency and duration of administration).

2.5 Definitions

Hypertension was defined as systolic blood pressure>140mmHg and diastolic blood pressure>90mmHg [14]. Waist-to-hip ratio of >1.0 and >0.85 were taken as cutoff for obesity in men and women. Waist circumference of >90cm and >80cm were taken as cutoff for obesity in men and women, respectively, using WHO definition [15]. BMI was calculated using the formula: weight (kg)/height (m) ^{2}[16].

Smokers in India consume tobacco in various forms: rolled tobacco leaves (bidi), Indian pipe (chillum, hookah), cigarettes and chewing tobacco. Anyone smoking in any form at least once a time per day for the minimum past six months includes ex-smokers was considered as smoker, and others were classified as non smokers [14]. For Alcohol intake, subjects were categorized as abstainer who never consumed alcohol, and the subject who consumed alcohol more than 30 ml of ethanol/day, 720 ml of beer/day, and 300ml/day of wine were categorized as heavy drinker [17].

2.6 Data Entry & Stat Analysis

Data thus generated, was entered and analyzed using SPSS 16.0. Prevalence of type 2 diabetes mellitus is presented as percentage. Inter group comparison among individuals were done using chi-square for categorical variables and student t-test for quantitative variables. Odds ratio was calculated for different risk factors. Multivariate logistic regression models were used to examine the relationship of diabetes mellitus with fasting blood glucose, BMI, smoking, alcohol intake, age and family history. $P<0.05$ was used as the definition of statistical significance.

3. Results

A total 18021, patients were examined out of which 861 patients (4.70%) were found to be type 2 diabetes mellitus (figure 2). There were more females (51.66%) than males (41.34%) [Table 1]. This is the most common frequent disease in non communicable category leads to COPD, CNS disorder, essential hypertension and followed by cardiac arrthymia (2.70%), Ischemic heart diseases (2%). The comparison of anthropometric characteristics and biochemical parameters as shown in table 2. The mean waist circumference ($P=0.038$), waist hip ratio ($P=0.013$), systolic blood pressure ($P<0.001$) and fasting blood glucose ($P=0.017$) was significantly higher in cases with diabetes mellitus than normal controls. For men, the statistically significant higher among these waist circumference ($P=0.019$), waist hip ratio ($P=0.035$), BMI ($P=0.005$), systolic blood pressure ($P=0.004$), fasting blood glucose (p=0.0002), HDL ($P=0.041$) and triglycerides ($P=0.002$) in diabetes mellitus patients when compared to normal control (Table 3). In females same anthropometric and biochemical parameters were higher with addition to diastolic blood pressure ($P=0.049$) respectively

except waist hip ratio shows non-significant (Table 4).

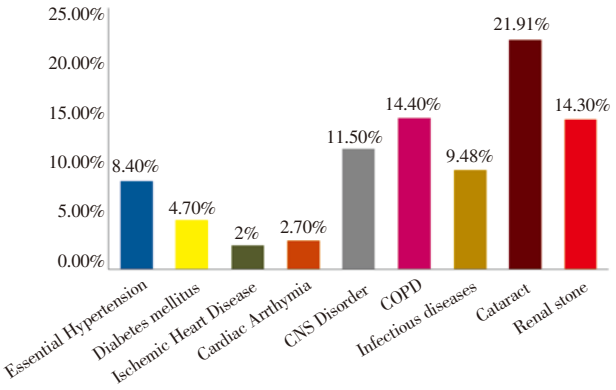

Figure 2 Percentage of patients with different diseases who visited the OPD of medicine in rural region of Haryana at MMIMS, Mullana since 2007 to 2010.

Table 1

Distribution of type 2 diabetes mellitus with Normal control population on the basis of Age and Sex.

Age groups	Cases with Diabetes Mellitus (60)		Normal control (59)	
	Male	Female	Male	Female
20–30	00	00	00	00
31–40	03	04	02	02
41–50	03	11	08	09
51–60	14	13	10	11
61–70	06	03	04	09
71–80	03	00	03	01
Total	*n*=29(48.34%)	*n*= 31(51.66%)	*n*=27(45.76%)	*n*=32 (54.23%)

3.1 Risk factors for diabetes mellitus

Risk factors for diabetes mellitus were analyzed using multivariate logistic regression analysis (Table 5). The significant determinants of diabetes mellitus were body mass index (odd ratio: 4.082, P=0.019) and fasting blood glucose

Table 2

Comparison of demographic, anthropometric and biochemical features between Normal control and type 2 diabetes mellitus patients.

Parameters	Cases with Diabetes mellitus (N = 60)	Normal control (N=59)	*P* value
Males/Females	29/31	27/32	ns
Age (years)	53.61±10.31	55.67±8.89	ns
Height (cm)	160.78±8.77	164.91±8.02	ns
Weight (kg)	66.62±13.79	60.57±7.66	ns
BMI (kg/m2)	25.66 ±4.13	22.21±1.96	ns
Waist circumference(cm)	38.81±5.77	30.67±2.79	*
Hip circumference (cm)	40.83±5.17	39.40±3.21	ns
Waist hip ratio	0.94±0.080	1.29±0.10	*
Systolic Blood Pressure (mm hg)	146.28±19.74	115.57±6.53	**
Diastolic Blood Pressure (mm hg)	91.55±7.09	75.88±6.01	ns
FBG (mg/dl)	215.83±77.09	103.62±33.40	*
HDL(mg/dl)	42.63±4.46	50.67±3.28	ns
LDL(mg/dl)	103.79±16.69	108.16±15.25	ns
Triglycerides (mg/dl)	204.08±72.57	138.25±8.69	ns
Total Cholesterol (mg/dl)	204.24±27.18	181.10±13.91	ns
Alcohol Consumers	16 (26.66%)	15 (25.42%)	ns
Cigarette Smokers	16(26.66%)	14 (23.72%)	ns
Family History of diabetes	13(21.66%)	10 (16.94%)	ns

Table 3

Comparison of Biochemical and Anthropometric parameters between type 2 diabetes mellitus males versus Normal control males.

Parameters	Cases with Diabetes mellitus (N=29)	Normal Control (N = 27)	*P* Value
Waist Circumference(cm)	40.48±6.40	30.96±2.90	*
Hip Circumference (cm)	41.86±6.35	39.37±2.60	ns
Waist hip ratio	0.96±0.077	1.28±0.109	*
Weight (kg)	71.76±15.77	63±7.79	ns
Height (cm)	166.58±6.96	166.85±7.56	ns
BMI (kg/m2)	45.84±6.65	20.89±6.31	**
Systolic Blood Pressure (mm hg)	176.74±19.21	115.33±15.23	**
Diastolic Blood Pressure (mm hg)	90.62±8.65	75.70±6.33	ns
FBG (mg/dl)	312.87±75.77	103.25±39.22	***
HDL(mg/dl)	40.77±4.73	49.55±3.09	*
LDL(mg/dl)	99.38±15.80	109.74±15.28	ns
Triglycerides (mg/dl)	215.11±89.69	139.03±17.75	**
Total Cholesterol (mg/dl)	209.55±31.55	182.81±14.97	ns

Table 4

Comparison of Biochemical and Anthropometric parameters between type 2 diabetes mellitus females versus Normal control females.

Parameters	Cases with Diabetes mellitus (N=31)	Normal Control (N = 32)	*P* Value
Waist Circumference(cm)	45.25±4.71	30.43±2.72	***
Hip Circumference (cm)	39.87±3.60	39.43±3.69	ns
Waste hip ratio	0.105±0.22	0.91±0.079	ns
Weight (kg)	61.80±10.45	58.53±7.03	ns
Height (cm)	155.35±6.53	163.28±8.15	ns
BMI (kg/m2)	45.49±7.76	22.49±5.06	**
Systolic Blood Pressure (mm hg)	145.87±20.54	115.78±7.53	**
Diastolic Blood Pressure (mm hg)	92.41±6.08	76.03±5.82	*
FBG (mg/dl)	221.40±79.34	103.93±28.23	**
HDL(mg/dl)	42.63±4.067	51.62±3.19	*
LDL(mg/dl)	107.90±16.69	106.84±15.33	ns
Triglycerides (mg/dl)	193.77±51.22	137.59±18.53	*
Total Cholesterol (mg/dl)	199.28±21.69	179.65±13.62	ns

Table 5

Multi Variant Logistic regression models for determination of predictors using, categorical variables.

Variables	Diabetes mellitus N (%)	Normal control N (%)	Odd ratio	95% CL	P value	β	S.E.	Wald
Overall	60	59						
BMI(kg/m2)								
<22.9	19	38		reference				
>23.0	41	21	4.082	(1.258–13.242)	0.019*	1.407	.600	5.488
Glucose level								
<126	5	49		reference				
>126	55	10	56.070	16.488–190.67	0.0001***	4.027	0.624	41.575
Systolic								
<140	30	59		reference				
>140	30	00	0.402	0.00–0.00	0.997	21.737	6.192	0.00
diastolic								
<90	34	58		reference				
>90	26	01	0.402	0.009–18.096	0.639	0.911	1.942	0.220
Smoking								
No	44	45		reference				
Yes	16	14	0.758	0.134–4.306	0.755	0.277	0.886	0.097
Alcohol use								
No	44	44		reference				
Yes	16	15	1.035	0.260–4.119	0.961	0.035	0.705	0.002
Sex								
Female	31	32		reference				
Male	29	27	0.648	0.152–2.767	0.558	.434	.741	0.343
Family history								
No	47	49		reference				
Yes	13	10	0.954	0.230–3.950	0.948	0.047	0.725	0.004

level (odd ratio: 56.07, $P<0.0001$). Smoking, alcohol use, family history, gender difference, systolic blood pressure and diastolic blood pressure did not find any risk predictor of diabetes mellitus.

4. Discussion

Diabetes mellitus is one of the major non communicable diseases which are growing very fast in this modern era. Diabetes and associated complications pose a major health care burden worldwide and present major challenge to patients, health care systems and national economies. Asia is the major site of a rapidly emerging diabetes epidemic [18]. India and China both are having highest number of diabetes patients in coming years. The smaller countries of the Indian subcontinent like Pakistan, Bangladesh and Srilanka were also witnessing a rapid increase in prevalence of type 2 diabetes [18]. Haryana is one of the famous states located in Northern part of India which reflects the more rural area than urban area. Our study is the third study showed prevalence of type 2 diabetes mellitus (4.70%) represent a fourth rank among other diseases in rural

population of Haryana which is low compared to two studies reported in different rural areas of Haryana, {Karnal (10.20%) [7] and Rohtak (8.1%) [19]}. Due to poor medical facilities and little support, a true population based survey is very difficult to carry out. Hence our study was conducted in a hospital setting which allowed us to gain reliable information and to follow up patients more easily. As consequence, the resulting prevalence of type 2 diabetes mellitus is not true population prevalence, but rather the prevalence in our outpatient population. It may be attributable to difference in population characteristics, study design and rural-urban differences. A community based study conducted by Zarger et al 2000 [6] estimated prevalence of diabetes in urban area (Kashmir) as 6.1%. It also revealed that the prevalence in the southern part of India to be higher 13.5% Chennai, 12.4% Bangalore and 16.6% Hyderabad compared to Eastern India (Kolkatta) 11.7%, Northern India (New Delhi) 11.6% and Western India (Mumbai) 9.3% [19]. Survey in different countries, Mexican Americans 25.7%, aboriginal Australians 25%, non Hispanic blacks 19.8% has been reported [20, 21]. In our studied population, females were more vulnerable to diabetes than males which is similar to Arora et al 2001 [19] and Sharifi et al 2010 [22] study and contradictory results to southern population in India reported Venkatesham et al 2010 [23]. A different study reported of elderly population (age $\geqslant$ 65 years) on prevalence of type 2 diabetes increases with increasing age [23, 24] but different findings were observed in our studied population that type 2 diabetes are more risky at age between 51-60 years. Some other study reported on Indian population that onset of T2DM at all age groups in comparison with Europeans [25]. Therefore, rural population of Haryana like other Asian Indians have a low age threshold for the risk of T2DM compared to other study reported at age of above 65 yrs [23]. The value of Fasting Blood Glucose is showing more significant association with diabetes in our studied population. Moreover anthropometric variables have been found to be good predictor of susceptibility to T2DM [26]. BMI has been shown to be a significant risk factor in various Indian and Asians population like Pakistanis, Chinese, Beijing, Hong Kong population, Mauritius Indians, Filipino and Japanese Funagata population [27, 28, 29]. Similar observation was also seen in our studied population in BMI which showed positive association with diabetes. The average values of BMI in Asian Indians appears to increase with urbanization and were observed to be higher than in Caucasians, Mexican Americans and African populations. However, the cut off value for ideal BMI is less as compare to other population [30, 31]. There is a significant increase in the risk as the BMI exceeds (23kg/m2) therefore the risk of developing T2DM starts at a lower BMI level in Asian population. Multivariate logistic regression analysis found the significant association between the BMI and fasting blood glucose level in diabetes mellitus patients to confirm risk factor of diabetes.

Evidence in support of the above hypothesis was obtained in a recent study of rural population of Haryana which is in a transitional stage of urbanization. Although living in rural areas, they have access to modern amenities like use of electric home appliances, watching TV for entertainment and driving motor bikes and cars. This has brought down the physical activity level considerably in several persons. In addition, there was a also change in the diet pattern from the conventional rural pattern, with higher intake of fats and refined carbohydrates. The most interesting features was the impact of decreased physical activity resulted in increased risk of glucose intolerance in our study population. Our study concludes that prevalence of diabetes mellitus in rural population is less as compared to other states. The gender difference and age factor is the important factor to predict the diabetes mellitus disorder. There is a wide urban-rural difference in the prevalence of diabetes as shown in several studies. This could be due to common etiological factors, namely presence of familial aggregation and the environmental influence associated with urbanization.

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Conflicts of interest

None identified

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